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EVALUATION OF DIFFERENT PLANT EXTRACTS AGAINST CITRUS PSYLLA (*Diaphorina citri* KUWAYAMA)

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ABSTRACT

Bioassay was conducted to compare the efficacy of different botanical insecticides against adult citrus psylla (Diaphorina citri) during the year 2013 at Agriculture Research Institute, (Tarnab) Peshawar, Pakistan. Eight plant poisons viz. Datura alba 10%, Datura alba 20%, Calotropis procera 10%, Calotropis procera 20%, Parthenium hysterophorus 10%, Parthenium hysterophorus 20%, Azadirachta indica 10%, Azadirachta indica 20%, and one synthetic insecticide (Lorsban) used as a standard were selected for the study. Data were recorded at three weeks interval. Population density of citrus psylla was recorded as number of adults per branch. Overall mean No. of adults were minimum in Lorsban (11.13) followed by C. procera 20% (12.88), while on control maximum population was observed as 41.44 adults branch^{-1}. In the plant poisons, possessing offensive properties, fewer adults were observed as compared to control, revealed the effect of botanicals repellency against citrus pest. Calotropis procera 20% and Lorsban were found to be the most effective treatments as compared to the other treatments. However, all the plant extracts offered statistically comparable control with Lorsban.

Key words: Botanicals, citrus psylla, *D. citri,* plant extracts, sour orange.

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INTRODUCTION

The climate of Khyber Pukhtunkhwa is very congenial for the production of different citrus species, cultivated in the sub-continent since ancient times due to its nutritional and economic importance of

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these fruits and the favorable climatic condition of the region. The average area under citrus cultivation in Pakistan is about 194.5 million hectares with total production of 1982.2 million tons annually (MINFA, 2010-11). Pakistan exported 432061.494 metric tons of citrus (Kinnow and other cultivars) fruits to other countries and generated enormous amount of foreign exchange up to 15978.124 million rupees (MINFA, 2010-11).

Pakistan is among the leading citrus growing countries of the world. In Pakistan citrus are grown in Sargodha, Multan, Faisalabad, Sahiwal, Khanewal and Okara in Punjab and many districts of Khyber Pukhtunkhwa viz., Malakand, Swat, Haripur, Mardan, Dir Upper and Lower. Citrus fruits including sweet oranges, mandarins, pummelos, grape fruit, lemons, limes and tangoles are rich sources of vitamin C (Jillani *et al.,* 1989).

There are approximately 200 species of insect pests causing infestation to citrus fruit cultivars across the globe, among insect pests citrus psylla is one of the major insect pests of citrus in Khyber Pakhtunkhwa. Both the nymphs and adults of *D. citri* suck cell sap from immature foliage and twigs with the help of their piercing mouth parts that cause curling and defoliation of leaves, flowers and die back of branches from top to bottom. Resultantly, premature dropping of fruits occur (Shah and Saleem, 2000). Maximum infestation damages the growing tips, while excessive population can distort shoots and leaves resulting towards the death of plant within 4-5 years (Bove, 2006). Feeding of this insect leads honeydew production that results in sooty mould. Badly injured leaves die and fall, consequently defoliation of branches takes place. It is reported that saliva of the pest creates such distortion (Dennis, 1983).

Usually, during first year of infestation, damages are not well-specified but soon production minimizes and many top branches dry up. During second year of infestation, new shoots get deformed, defoliation occurs. Afterward, tree begins to dry and bears little, savorless fruits. During third year of infestation, neither the leaves remain nor does fruit set occur (Bove, 2006; Husain and Nath, 1927; Bindra, 1969). Although there is a visible difference in the ascent and descent of citrus psylla population in respective seasons, yet the ill effects of the pest are so durable that the trees may seem sick even when the pest population is not noticeable. Thus, sickness and coal black are symptoms due to this insect pest appear in winter in consequence to the infestation during previous summer (Atwal, 1976).

It has been reported that citrus psylla is also a vector greening disease of citrus (Catling, 1970). Three peaks of nymphal population of citrus psylla are recorded, first in the mid of April, second in the end of June and third at the end of September (Sahu and Mandal, 1997). A

negative correlation between *D. citri* population and relative humidity is known to exist. Only few nymphs are observed in the month of January when mean temperature is very low.

Many pesticides are used to control citrus psylla in which dimethoate; monocrotophos, phosphamidon, decamethrin and fenvalerate give suitable control as compared to Cypermethrin, Chloryrifos, Dichlorvos, Endosulfan, Malathion and Quinalphos (Dahiya *et al.,* 1994). The pesticides used for managing insect pests not only pose health threats but also stimulate environment contamination (Irshad and Gillani, 1989). Resistance to one or more groups of pesticides has been recorded; at least 447 insects and mites are also among them (Georghio *et al.,* 1986). Moreover, repeated application of synthetic chemicals has distressed natural biological control system by natural enemies and also led to the outbreaks of minor insect pest (Subramanyam and Hagstrum, 1995; White and Leesch, 1995),

The constraints of synthetic chemicals necessitate the exploration of other insecticides that are pest specific, environment friendly, having least risks of insect resurgence / resistance and cost effective. Insecticides originating from native plants have shown their potential in this regard and may prove to be an excellent substitute to the already existing insecticides (Wink, 1993).

Nowadays a new better trend of utilization of alternative sources like plants, microorganisms and venomous arthropods as insecticides has been established (Arnason *et al.,* 1989). These new sources have great potential to provide biochemical compounds with a natural and remarkable mode of action. More than 2400 plant species are known to have insecticidal properties (Grainge and Ahmed, 1988: Jacobson, 1986).

Some of the oldest familiar plant poisons originated from plants include nicotine from tobacco leaves and flowers, pyrethrins from chrysanthemum flowers, a chemical rotenone from derris roots and ryania from the ground stem wood of the rynia shrub (Ware, 1980).In the recent years neem has been evaluated for its efficacy to suppress insect pests (Schmutterer, 1985; Kanvil *et al.,* 2006). Therefore, the present study was conducted to compare the efficacy of different botanical insecticides against adult citrus psylla.

MATERIALS AND METHODS

The research in hand was conducted to evaluate the efficacy of one synthetic insecticide and various plants extract against adult citrus Psylla (*Diaphorina citri* Kuwayama) in the field. The trial was carried out in the Entomology Section at Agriculture Research Institute (ARI) Tarnab Peshawar, Pakistan during August, 2013.

Collection of plant materials

The leaves and shoots of plants including *Calotropis procera* were collected from ARI Tarnab Peshawar during June, *Datura alba* from Nowshera and *Parthenium hysterophorus* from Mardan during July and Neem *(Azadirachta indica)* seeds were purchased from the local market during July, 2013. The collected plants were exposed in shade upto 5-7 days for drying (Rashmi *et al.,* 2011). All the plant parts of *C. procera*, *P. hysterophorus* and *D. alba* and neem seeds were preserved in the tagged jars.

Preparation of plant Extracts

The dried plants were chopped and grinded with the help of blender. The aqueous extract of plants was prepared under laboratory conditions on percent basis (Inam *et al.*, 2012). Grinded plant (leaves and shoots) upto one kg wrapped in muslin cloth were put in five liters hot water (80 ^{0}C) and retained for sixteen hours at room temperature. After 16 hours, the dipped material (grinded plants wrapped in muslin cloth) was squeezed which made 20% of aqueous solution of plants extracts. To make 10% of the aqueous solution, 0.5 kg instead of 1 kg of the plants were put in boiled water (Begum *et al.,* 2010).

Layout, Procedure and Data Collection

Thirty (30) citrus trees (sour orange variety) of equal size were selected representing ten treatments with three replications. Hence, each plant represented an experimental unit. On each plant 4 branches, one on each side, were randomly selected and tagged (Ahmed *et al.,* 2004). The insecticides were sprayed twice on the trees at three weeks interval early in the morning, whereas, the control was left untreated. The population of citrus psylla was counted on 20 leaves of each branch (total 80 leaves/tree). The data were recorded after 1, 2, 3, 7, 15 and 21 days of application of insecticides.

Statistical analysis

The data recorded were analyzed by repeated measurement analysis using Statistix 8.1 package taking spray as a repeated measure factor, whereas time and treatments were arranged in randomized complete block design. Means were compared using LSD test at 5 % level of significance ($P<0.05$).

RESULTS AND DISCUSSION

The analysis of the data revealed that the effects of the plant extracts, interval, spray, interval x treatment and spray x interval interactions were significant for mean No. of adults of *D. citri* population in sour orange orchard, however, the spray x treatment and spray x interval x treatment interactions were non-significant.

Data concerning the effect of various treatments on the adult *D. citri* are shown in Table-1. In control (untreated), the mean population of *D. citri* was the highest (41.4) among all the treatments. There are no statistical differences in using plant extracts at any rate. However, the minimum adult population of *D. citri* (12.88) was recorded for *C. procera 20%*. Similarly, *C. procera* 10% had a significantly higher adult population of *D. citri* (19.20) as compared to Lorsban (11.13), which itself was not significantly different than any other plant extracts (Table-1).

The mean adult population of *D. citri* (Table-1) increased linearly with increase in time interval. It is further indicated that minimum adults were recorded (13.19) on day 1 followed by 14.2 on day 2, 16.73 on day 3, 17.91 on day 7, 22.37 on day 14, as compared to maximum (27.96) recorded on day 21. Moreover, the results revealed that no differences were observed for *D. citri* adult population between 1st and 2nd days interval, as well as 3rd and 4th days interval, whereas other all post treatment days intervals are significantly different from each other.

Mean population of citrus psylla adults in response to number of sprays (Fig. 1) showed that population was lower (15) in case of two sprays as compared to one (23). Doubling the spray had resulted in about 35% decrease in adult population.

Interaction effect of Treatment x time intervals (Table-1) indicated that in all plant extracts treatments, the citrus psylla population density increased as the time passed. Similarly, in Lorsban treatment the same trend was observed, however in control treatment there was no regular increase or decrease in *D. citri* adult population. It is further indicated that minimum No. of *D. citri* adult population after 24 hrs was recorded in Lorsban (7.80), followed by *P. hysterophorus* 20% (8.50) as compared to maximum (43.50) in control. Likewise, after 48 hrs, lower population of *D. citri* adult (8.90) was recorded in Lorsban, followed by *P. hysterophorus* 20% (9.30) compared to control treatment (43.80). Repellent effect of *P. hysterophorus* might be due to the presence of biologically active compounds or synergistic effects of parthenin (Narasimhan and Murthy, 1984). Parthenium is also reported as a promising remedy against hepatic amoebiasis (Sharma and Bhutani, 1988), while Datta and Sexna (2001) concluded that *P. hysterophorus* plant extracts have good effect on pests of fruits which is in conformity with our results. Similarly, Shakil *et al.* (2005) reported the *P. hysterophorus* and its derivatives resulted in the control of different insects and root knot nematodes. Moreover, Hussain *et al.* (2011) indicated that *Parthenium* treated plants showed better results on suppressing melon fruit fly population.

The statistical analysis revealed that after 72 hrs lower numbers of adults were observed (9.60) in Lorsban, followed by *C. procera* 20% (12.00) while higher number were recorded (43.80) in control adults/ Branch, respectively. Similarly, observation were made after 7 days lower number of adults were recorded in Lorsban with the population density of (9.70) followed by *C. procera* 20% (12.70) where as higher numbers were observed in control, (42.00). While Larhsini *et al*. (1997) evaluated that alkaloids existence was observed in the latex of *C. procera* have been shown to comprise insecticidal properties, which support our results. Furthermore, Rashmi *et al.* (2011) indicated that *C. procera* extracts were quite effective and also showed better results against defoliators.

The data recorded after 14 days reduced population was observed on Lorsban with the population density of 10.80 followed by *C. procera* 20% (14.40) while in control maximum number of adults were recorded (36.90). The observation was made 21 days of the post spray data intervals revealed the lowest population were recorded (20.00) in Lorsban followed by *C. procera* 20% (20.20) as compared to control/ check (40.00) adults/ branch. Begum *et al.* (2011) was of the view that *C. procera* leaf extracts were quite effective and persistent and can provide an excellent alternate for suppressing pest populations. The larvicidal effect of *C. procera* was due to the allelochemicals like alkaloids and phenols these phytochemicals may be responsible for the insecticidal nature of the extracts. *C. procera* have some medicinal values and used as a treatment of toothache, cough and subcutaneous diseases which clearly indicated that *C. procera* do not have adverse effects on mammals (Begum *et al*., 2011).

Data regarding the interaction effect of spray x time (Fig. 2) revealed that in case of spray one minimum adult was observed 15.17 on day 1st followed by 16.83 on day 2nd, 20.71 on day 3rd 21.41 on day 7th, 26.62 on day 14th compared to maximum was recorded 35.72 on day 21st. while in case of spray two minimum number of adults were observed 11.22 on day 1st followed by 11.75 on day 2nd, 12.77 on day 3rd 14.43 on day 7th, 18.14 on day 14th while maximum number of adults were observed 20.21 on day 21st respectively.

Interaction effect of spray x treatment (Fig. 3) indicated that spray one minimum 16 on *C. procera* 20% as compared to maximum 44 in control. While incase of spray two minimum 5 on Lorsban followed by 10 on *C. procera* 20% compared to control 39 adults/ branch, respectively.

CONCLUSION

All insecticides were effective in controlling *D. citri* and two sprays significantly reduced *D. citri* population as compared to control. The effect of all botanical extracts reduced gradually after one week. Botanical extract of *C. procera* 20% or Lorsban should be applied two times with an interval of two weeks for effective control of *D. citri* under the prevailing agro-climatic conditions. Further studies should be conducted at various agro-climatic conditions to confirm the effect of these extracts against citrus psylla before wide spread recommendations.

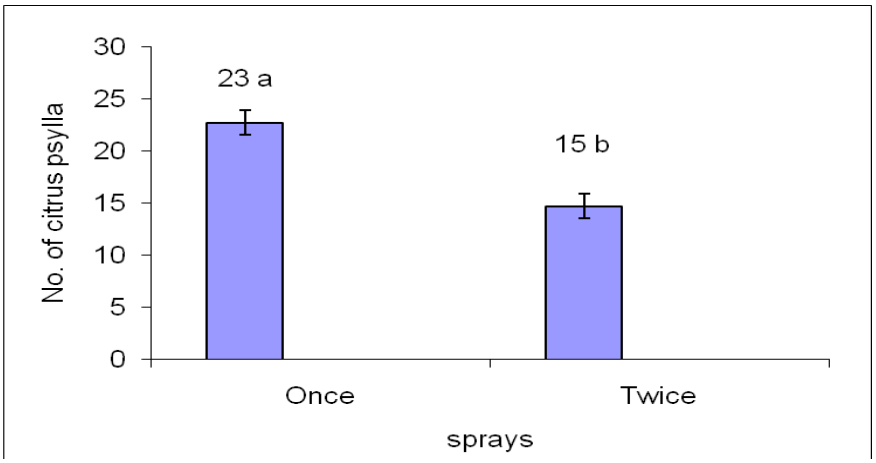

Figure 1. Adult population of citrus psylla in respose to spray frequency. Vertical bars are starndard errors of means.

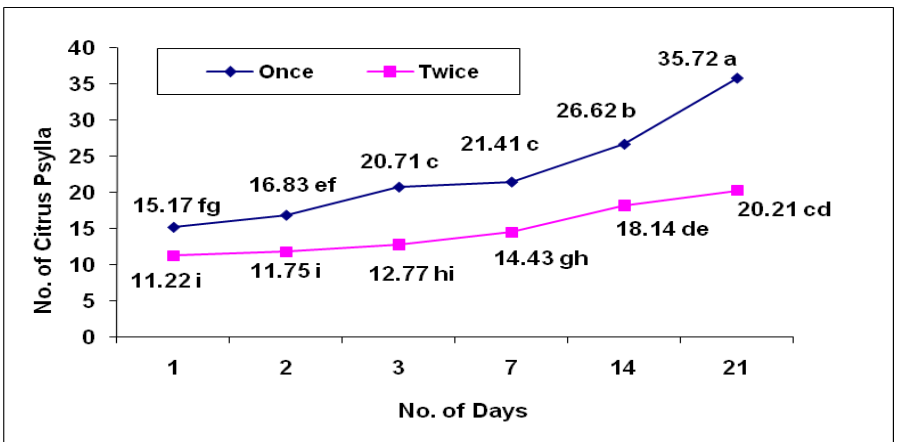

Figure 2. Effect of spray (Once and Twice) and time intervals on the population means of citrus psylla on citrus orchard

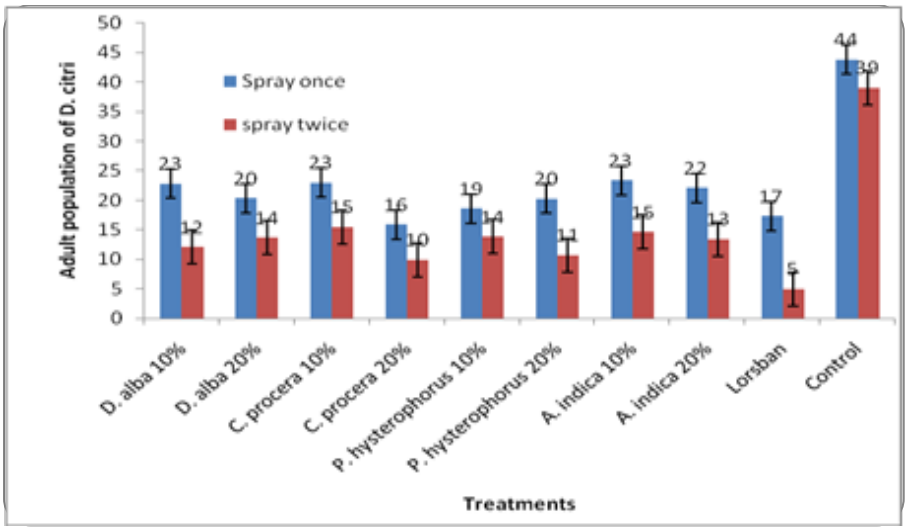

Figure 3. Effect of spray (Once and Twice) and treatment on the population means of *D. citri* on citrus (sour orange) orchard. Vertical bars are the standard error of means.

Table-1. Mean no. of adults branch^{-1} on various intervals on the population of (*Diaphorina citri* Kuwayama) in citrus sour orange orchard.

Treatments	Time						Means
	Day 1	Day 2	Day 3	Day 7	Day 14	Day 21	
D. alba 10%	10.30 o-r	12.10 k-r	15.30 h-o	15.30 h-o	24.00 d-e	27.60 c-d	17.44 bc
D. alba 20%	9.00 q-r	10.00 p-r	12.20 k-r	17.20 g-k	24.10 d-e	29.40 c	16.97 bc
C. procera 10%	10.70 n-r	12.50 k-r	15.30 h-o	18.80 f-i	27.10 c-d	30.80 c	19.20 b
C. procera 20%	8.60 q-r	9.40 p-r	12.00 l-r	12.70 k-r	14.40 i-p	20.20 e-h	12.88 bc
P. hysterophorus 10%	10.90 m-r	12.00 l-r	13.50 j-q	13.50 j-q	20.50 e-g	26.60 c-d	16.18 bc
P. hysterophorus 20%	8.50 q-r	9.30 p-r	14.40 i-p	15.50 g-n	18.30 g-j	27.00 c-d	15.50 bc
A. indica 10%	12.70 k-r	13.40 j-q	16.00 g-m	20.00 e-h	23.50 d-f	28.20 c-d	18.97 bc
A. indica 20%	9.90 p-r	11.60 l-r	16.60 g-l	14.40 i-p	24.00 d-e	29.88 c	17.72 bc
Lorsban	7.80 r	8.90 q-r	9.60 p-r	9.70 p-r	10.80 n-r	20.00 e-h	11.13 c
Control	43.50 a	43.80 a	42.50 a	42.00 a-b	36.90 b	40.00 a-b	41.4 a
Means	13.19 d	14.29 d	16.73 c	17.91 c	22.37 b	27.96 a	

Means followed by same letter(s) are not significantly different at 5% level of significance using LSD Test.
LSD value for time = 1.60, LSD value for treatment = 8.03, LSD value for time x treatment = 5.16

REFERENCES CITED

Ahmed, S., N. Ahmad and R.R. Khan. 2004. Studies on population dynamics and chemical control of Citrus psylla, *Diaphorina citri*. Int. J. Agric. Biol. 6(6): 970-973.

Arnason, J.T, B.J.R. Philogene and P. Morand. 1989. Insecticides of plant origin. ACS symposium series 387. Amer. Chem. Soc., Washington, D. C 213p

Atwal, A.S. 1976. Agricultural pests of India and south-east Asia. Kalyani publishers Ludhiana, Delhi. pp. 195-213.

Begum, N., B. Sharma and R.S. Pandey. 2011. Evaluation of insecticidal efficacy of *C. procera* and *A. suamosa* ethanol extracts against *Musca domestica*. J. Biofert. Biopest. 1:101 doi: 10.4172/2155-6202. 1000101.

Begum, N., B. Sharma and P.S. Pandey. 2010. Toxicity potential and anti-ache activity of some plant extracts in *Musca domestica*. J. Biofertil. Biopestic. 2:108. doi:10.4172/2155-6202.1000108.

Bindra, O.S. 1969. *In*: Review of work done*,* lacunae in our knowledge and future lines of work*.* ICAR workshop, Fruit Research, P.A.U. Ludhiana. April. pp. 28-30.

Bove, J.M. 2006. Huanglongbing: a destructive, newly emerging, century-old disease of citrus. J. Plant Pathol. 88: 7-37.

Catling, H.D. 1970. Distribution of the psyllid vectors of citrus greening disease, with notes on the biology and bionomics of *Diaphorina citri*. FAO Plant Prot. Bull. 18: 8-15.

Dahiya, K.K., R.K. Lakra, A.S. Dahiya and S.P. Singh. 1994. Evaluated the bioefficacy of some insecticides against citrus psylla, *Diaphorina citri* Kuwayama (Hemiptera: Psyllidae)). Crop Res. 8(1): 137-140.

Datta, S. and D.B. Saxena. 2001. Pesticidal properties of parthenin (from *Parthenium hysterophorus* L.) and related compounds. Pests Manag. Sci., 57 (1): 95-101.

Dennis, S.H. 1983. Agricultural insect pest of the tropics and their control. Cambridge Uni. Press. 2(1): 289.

Georghio, G.P. 1986. The magnitude of the resistance problem in pesticide resistance: Strategies and Tactics for the management of pests. National Academy Press, Washington, D.C.14.

Grainge, M. and S. Ahmad. 1988. Handbook of plants with pest control properties. John Wiley and sons, USA. pp. 470.

Husain, M. A. and D. Nath. 1927. The citrus psylla (*Diaphorina citri*, Kuw.) (Psyllidae: Homoptera) Mem. Dept. Agr. India 10: 1-27.

Hussain, A., S. Ahmad, G. Hassan, A. Amin, Z. Hussain and N. Muhammad. 2011. The bioefficacy of different plant extracts against Melon Fruit Fly in Bitter Gourd. Pak. J. Weed Sci. Res. 17(2): 143-149.

Irshad, M. and W. A. Gillani. 1989. Resistance in *Tribolium castaneum* (Herbst). (Coleoptera: Tenebrionidae) to malathion in Pakistan. Pak. J. Zool. 22(3): 257-261.

Jacobson, M. 1986. The neem tree: natural resistance of plants to pests: role of Allelochemicals. *In:* M.B. Green and P.A. Hedin (eds), American Chemical Society. Washington D.C. p. 220.

Jillani, M.S., M. Ishtiaq and A. Ghaffoor. 1989. Physico-chemical characteristics of sweet oranges (*Citrus sinensis* L.) cultivars grown in D.I. Khan. Sarhad J. Agri. 5(2): 145-148.

Kanvil, S., G. Jilani and J.U. Rehman. 2006. Repellency of acetone extracts of some indigenous plants against *Tribolium castaneum* (Herbst) (Coleoptera: Tenebrionidae). Pak. J. Zool. 38(4): 297-303.

Inam, K., M. Zahid and G. Z. Khan. 2012. Toxicity of botanic and Synthetic Pesticides Residues to Citrus Psyllid *Diaphorina citri* Kuwayama and *Chrysoper lacarnea* (Stephens). Pak. J. Zool. 44(1): 197-201.

Larhsini, M., M. Bousad, H.B. Lazrek, M. Jana and H. Amarouch. 1997. Evaluation of antifungal and molluscidal properties of extracts of *Calotropis procera*. Fitoterapia, 68: 371-373.

MINFA. 2010-11. Agricultural statistics of Pakistan, Ministry of Food Agriculture Division. pp. 89. Islamabad.

Narasimhan, T.R. and B.S.K. Murthy. 1984. Characterization of toxin from *Parthenium hysterophorus* and its mode of excretion in animals. J. Biol. Sci. 6: 729-738.

Rashmi, K., P. Singh and A. Suchita. 2011. Studies on the phytochemical profile and evaluation of insecticidal efficacy of *Calotropis procera* against defoliators. J. Medic. Plants Res. 31(5): 6738-6743.

Sahu, S.R. and S.K. Mandal. 1997. Population dynamics of citrus psylla, *Diaphorina citri* Kwayama (psyllidae: Hemiptera). J. Interacadem. 1:329-32.

Schmutterer, H. 1985. Which insect can be controlled by the application of neem seed kernel extracts under field conditions? Zeitschrift furangew and te Entomol, 100: 468-475.

Shah, H.A. and M.A. Saleem. 2002. Applied Entomol. pp. 151-152. 2nd Ed. Izharsonsb Printers Lahore.

Sharma, D. R. 2008. Population dynamics in relation to abiotic factors and management of Citrus psylla in Punjab. Indian J. Hort. 65(4): 417-422

Sharma, G.L, and K.K Bhutani. 1988 Plant based antiamoebic drugs. Part II. Amoebicidal activity of parthenium isolated from *Parthenium hysterophorus.* Planta Medica, 54: 20-22.

Shakil, N.A., D.B. Saxena, D. Prasad, A.K. Gupta and S. Kirti. 2005. Bio-activity of *Parthenium* and its derivatives against insects and root-Knot Nematode. Ann. Plant Prot. Sci. 13(1): 13-17.

Subramanyam, B. and D.W. Hagstrum. 1995. Resistance measurement and management. In: Subramanyam, B., Hagstrum, D.W. (Eds). Integrated Managemnt of insects in stored products. Marcel Dekker, New York. pp. 331-397.

Ware, G.W. 1980. Complete guide to pest Control-with and without chemicals. Thomson Pub., Fresno, CA. p. 290.

White, N.D.G and J.G. Leesch. 1995. Chemical control. *In:* B. Subramanian and D.W. Hagstrum (eds.). Integrated management of insects in stored products, Marcel Dekker, New York. pp. 287-330.

Wink, M. 1993. Production and application of phytochemicals from an agricultural perspective. *In:* T.A. van Beek and H. Breteler. (eds.). Photochemistry and Agriculture. Clarendon, Oxford, UK. 34: 171-213.